Eurasia Journal of Mathematics, Science and Technology Education 2018 vol.14 N4, pages 1305-1315

Teaching of mathematical modeling elements in the mathematics course of the secondary school

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© Authors. The urgency of the problem under investigation is due to the role of mathematical modeling in modern science and human practice, which requires the acquaintance of students with the elements of this process at the early stages of education. Training of mathematical modeling shows the students how to apply mathematics in real life, which is also a motivation for learning the subject. The purpose of the research is to identify elements of mathematical modeling that can and should be appropriately formed at the secondary school. The leading method of the research is the analysis of the structure of the mathematical modeling process and the development of a system of tasks aimed to form training activities that are adequate to the identified elements. The authors offer to use the system of changed tasks contained in school mathematics textbooks. The article proves the necessity of acquaintance of schoolchildren with the structure of the process of mathematical modeling, features of models, purpose of their use. As a result of the research, the authors present a model of the system of problems aimed to form elements of mathematical modeling relating to the stages of formalization and interpretation. The methodology proposed in the article can be used by mathematics teachers at lessons and elective courses, authors of textbooks and manuals, and also can be the basis for special courses for students of pedagogical universities.

http://dx.doi.org/10.29333/ejmste/83561

Keywords

Elements of mathematical modeling, Stages of formalization and interpretation, Tasks for the formation of elements of mathematical modeling

References

[1] Abaturova, V. S. (2010). Mathematical modeling in the teaching of mathematics as a means of forming cognitive independence of students in specialized economic classes. Yaroslavl: Yaroslavl State Pedagogical University

[2] Bavrin, I. I. (1993). The beginning of analysis and mathematical models in natural science. Mathematics at school, 4, 43-48

[3] Blomhøj, M., & Hoff Kjeldsen, T. (2006). Teaching mathematical modelling through project work. Zentralblatt für Didactik der Mathematik, 38(2), 163-177. https://doi.org/10.1007/BF02655887

[4] Burkhardt, H., & Pollak, H. O. (2006). Modeling in math classes: reflections on past events and future. Zentralblatt für Didaktik der Mathematik, 38(2), 178-195. https://doi.org/10.1007/BF02655888

[5] Bylkov, B. C. (1986). Teaching schoolchildren to some elements, mathematical modeling. Mathematics at school, 1, 53-55

[6] Dorofeev, G. V., & Peterson, L. G. (2013). Mathematics 5: textbook for secondary school. Moscow: Juventa Publ

[7] Dvoryatkina, S. N. (1998). Intersubject communications and applied orientation of the school course of mathematics in classes of biological profile (Doctorate Dissertation). Moscow: Moscow Pedagogical University

[8] Edelstein-Keshet, L. (1988). Mathematical Models in Biology. New York: McGraw Hill

[9] Egupova, M. V. (2014). Practical-oriented teaching of mathematics at school. Moscow: Moscow State Pedagogical University

[10] Federal state educational standard of secondary (complete) general education (2012). Retrieved from http://www.xn-80achddrlnpe7bi.xn-p1ai/index.php/fgosob.html

[11] Firsov, V. V. (1974). Some problems of teaching of probability theory as an applied discipline (Doctorate Dissertation). Moscow: Moscow State Pedagogical Institute

[12] Firsov, V. V. (1977). On applied orientation in the course of mathematics. In-depth study of algebra and analysis. Moscow: Prosveshchenie Publ

[13] Fridman, L. M. (1983). Psychological and pedagogical foundations of teaching mathematics at school. Moscow: Prosveshenie Publ

[14] Fridman, L. M. (1984). Visibility and modeling in teaching. Moscow: Znanie Publ

[15] Ivanova, O. V. (2003). The role and place of mathematical models in biological and chemical classes. Theory and practice of teaching mathematics and computer science: past, present, future. Materials of 10 Interregional scientific-practical conf. of teachers of innovative educational institutions and universities. Irkutsk: IGLU, 99-101

[16] Ivanova, O. V. (2004). Technology of the integrated lesson of mathematics. Modernization of modern education: theory and practice: Sat. sci. works. Moscow: IT & I RAO, 282-288

[17] Kaiser, G., & Schwarz, B. (2006). Mathematical modelling as bridge between school and university. Zentralblatt für Didactik der Mathematik, 38(2), 196-209. https://doi.org/10.1007/BF02655889

[18] Khomutsky, V. D. (1981). Intersubject relations in teaching the basics of physics and mathematics at school. Chelyabinsk: HSPI Publ

[19] Kim M., & Aktan, T. (2014) How to Enlarge the Scope of the Curriculum Integration of Mathematics and Science (CIMAS). Eurasia Journal of Mathematics, Science & Technology Education, 10(5), 455-469. https://doi.org/10.12973/eurasia.2014.1115a

[20] Kolyagin, Yu. M., & Pikan, V. V. (1985). On the applied and practical orientation of teaching mathematics. Mathematics at school, 6, 27-32

[21] Krutikhina, M. V. (2004). Teaching some elements of mathematical modeling as a means of preparing for a profile education. Mathematical bulletin of pedagogical colleges and universities of the Volga-Vyatka region, 6, 246-254

[22] Lesh, R., & Doerr, H. (2003). Foundations of a Models and Modelling Perspective on Mathematics Teaching. Learning and Problem Solving. In Lesh, R. & Doerr, H. (eds.) Beyond Constructivism. Models and Modeling Perspectives on Mathematical Problem Solving, Learning, and Teaching. Mahwah: Lawrence Erlbaum Associates, 3-33

[23] Lester, F. K., & Kehle, P. E. (2003). From Problem Solving to Modelling: The Evolution on Thinking About Research on Complex Mathematical Activity. In Lesh, R. & Doerr, H. (eds.), Beyond Constructivism. Models and Modeling Perspectives on Mathematical Problem Solving, Learning, and Teaching. Mahwah: Lawrence Erlbaum Associates, 501-517

[24] Lingefjard, T. (2006). Faces of mathematical modeling. ZDM Mathematics Education, 38(2), 96-112. https://doi.org/10.1007/BF02655884

[25] Lozhkina, E. M. (2008). Teaching mathematical modeling in the course of algebra at secondary school as a condition for developing the educational and cognitive competence of students (Doctorate Dissertation). St. Petersburg: RSPU

[26] Luneeva, O. L. (2011). Integrative approach to the implementation of schoolchildren's educational projects in mathematics and natural science disciplines. Concept, 3, 21-25. Retrieved from http://e-koncept.ru/2011/11305.htm

[27] Luneeva, O. L., & Zakirova, V. G. (2017). Integration of Mathematical and Natural-Science Knowledge in School Students' Project-Based Activity. Eurasia Journal of Mathematics, Science & Technology Education, 13(7), 2821-2840. https://doi.org/10.12973/eurasia.2017.00720a

[28] Melnikov, Yu. B., Solovyanov, V. B., & Shirpuzhev, S. V. (2017). Research and project activity of trainees from the positions of modeling theory. Pedagogical Journal, 7(2A), 36-49

[29] Michelsen, C. (2006). Functions: a modelling tool in mathematics and science. ZDM Mathematics Education, 38(3), 269-280. https://doi.org/10.1007/BF02652810

[30] Mordkovich, A. G. (1996). A new concept of the school course in algebra. Mathematics at school, 6, 28-34

[31] Morozov, G. M. (1978). The problem of forming skills associated with the application of mathematics (Doctorate Dissertation). Moscow: Moscow State Pedagogical Institute

[32] Ocampo, D., Santos, M., & Folmer, V. (2016). Interdisciplinary Teaching Is Possible? Pros and cons in perspective of a Mathematics teacher. Bolema [online], 30(56), 1014-1030. https://doi.org/10.1590/1980-4415v30n56a09

[33] Ovezov, A. (1991). Features of reasoning in applications of mathematics. Mathematics at school, 3, 45-49

[34] Polyakova, S. Yu. (1999). Learning the mathematical modeling of social processes as a means of humanizing mathematical education (Doctorate Dissertation). Omsk: Omsk State University

[35] Salmina, N. G. (1981). Types and functions of materialization in education. Moscow: Moscow State University

[36] Shapiro, I. M. (1990). Use of problems with practical content in the teaching of mathematics. Moscow: Prosveshenie Publ

[37] Skvortsova, M. (2003). Mathematical modeling. Mathematics, 14, 1-4

[38] Stukalov, V. A. (1976). Use of ideas about mathematical modeling in teaching mathematics (Doctorate Dissertation). Moscow: Moscow State Pedagogical Institute

[39] Tereshin, N. A. (1990). Applied orientation of the school course of mathematics. Moscow: Prosveshenie Publ

[40] The Concept of the development of mathematical education in the Russian Federation (2013). Russian Newspaper, 27th December. Retrieved from http://www.rg.ru/2013/12/27/matematika-site-dok.html

[41] Tselischeva, I. I., & Zaitseva, S. A. (2008). Modeling in learning to solve text problems. Mathematics at school, 5, 36-44

[42] Usova, L. N. (1980). Formation of students' general skills in the implementation of intersubject communications. Intersubject communication of natural and mathematical disciplines. Moscow: Prosveshchenie Publ

[43] Voznyuk, N. E. (2013). Teaching mathematics in the chemical-biological (medical) classes. Theory, methodology and technology of subject education and upbringing in different educational fields. Collected materials of the annual international scientific conference. Moscow, 18-26

[44] Wozniak, G. M., & Gusev, V. A. (1985). Applied problems for extremes in the course of mathematics in 4-8 grades. Moscow: Prosveshchenie Publ

[45] Zelenina, N. A., & Krutikhina, M. V. (2011) Applied tasks in teaching mathematics in chemistry-biological classes. Bulletin of Vyatka State Humanitarian University, 4, 171-176

[46] Zelenina, N. A., & Krutikhina, M. V. (2014). On the problem of teaching mathematics in chemistry and biology classes. Trends in the prospects for the development of mathematical education: materials of the XXXIII International Scientific Seminar of Teachers of Mathematics and Informatics of Universities and Institutes of Higher Education dedicated to the 100th anniversary of Vyatka State Humanitarian University. Kirov: Vyatka State University, Raduga-Press Publ., 344-346

[47] Zeytun, A., Cetinkaya, B., & Erbas, A. (2017). Understanding Prospective Teachers' Mathematical Modeling Processes in the Context of a Mathematical Modeling Course. Eurasia Journal of Mathematics, Science & Technology Education, 13(3), 691-722. https://doi.org/10.12973/eurasia.2017.00639a

[48] Zubareva, I. I., & Mordkovich, A. G. (2013). Mathematics 5: textbook for secondary school. Moscow: Mnemosina Publ